ESSENCE – A DoD Health Indicator Surveillance System

2004 Environmental
Public Health Tracking Conference

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What is ESSENCE?

Electronic

Surveillance

System for the

Early

Notification of

Community-based

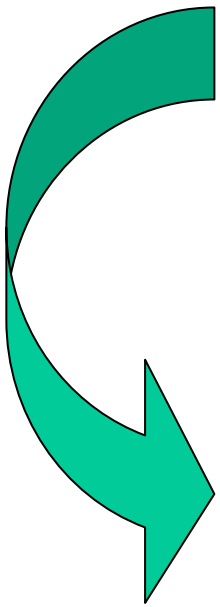
Epidemics

Need for Improved Surveillance

- **Current systems**
  - Often depend on laboratory confirmation
  - Rely on passive participation
  - Are not automated

- **New "health indicator" / "syndromic" surveillance**
  - Rapid, automated systems based on syndromes
  - Non-traditional data sources
    - ICD9 codes, pharmaceutical sales, ER chief complaints
  - May provide earlier indication of outbreaks
  - Quickly provide necessary demographic information

Multiple methods of disease detection



- Traditional reportable disease surveillance
- Sentinel surveillance
- Astute clinicians
- Syndromic surveillance

A “system of systems”

Presentation outline

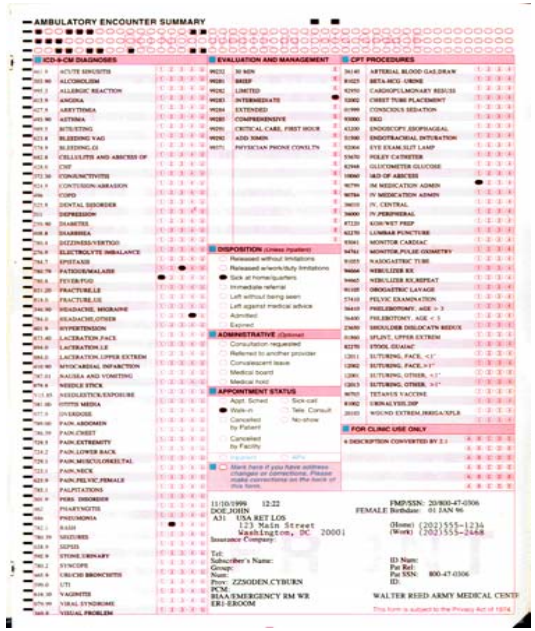
1. Identify near real time data
2. Symptom definitions
3. Data display
4. Identify abnormal trends
5. Privacy protection
6. Evaluation

1. Choosing near real time data

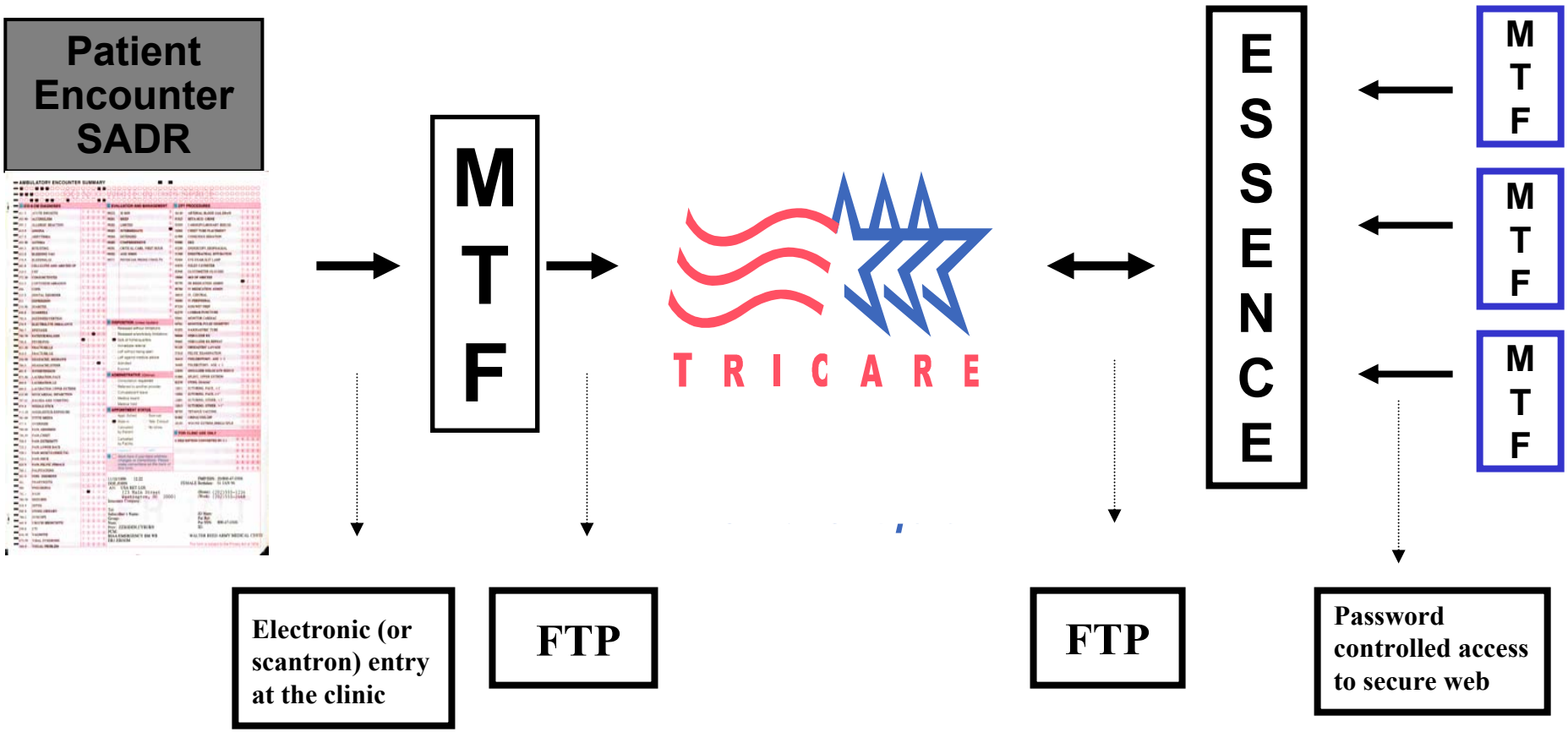
- Is the source already collected for another purpose?
- Is the source electronic?
- Is the source reliable?
- How long does it take ?

ESSENCE incorporates ADM encounter information

- One entry per patient encounter
- Diagnoses
- Disposition
- Procedures
- Patient demographics
- Clinic demographics


AMBULATORY ENCOUNTER SUMMARY

Current Basis for Daily Surveillance



ESSENCE Coverage

- December 1999

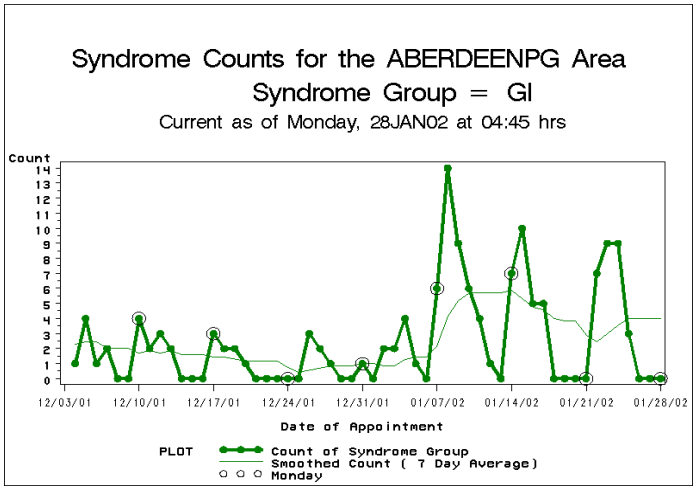
  National Capital Area (NCA)

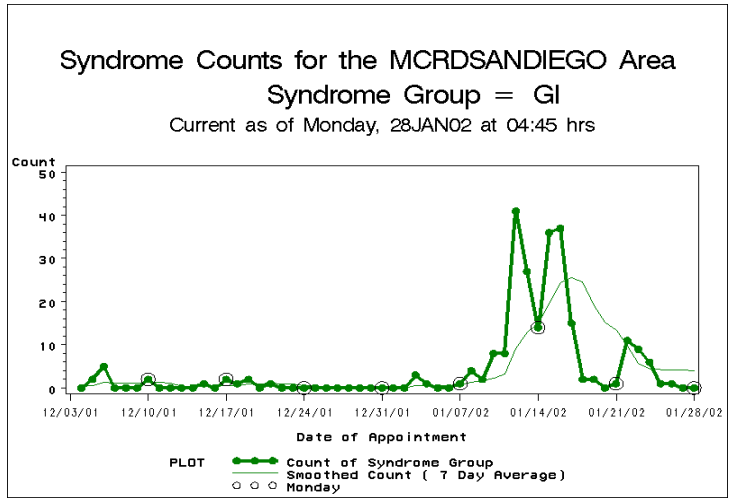
- September 2001 to present

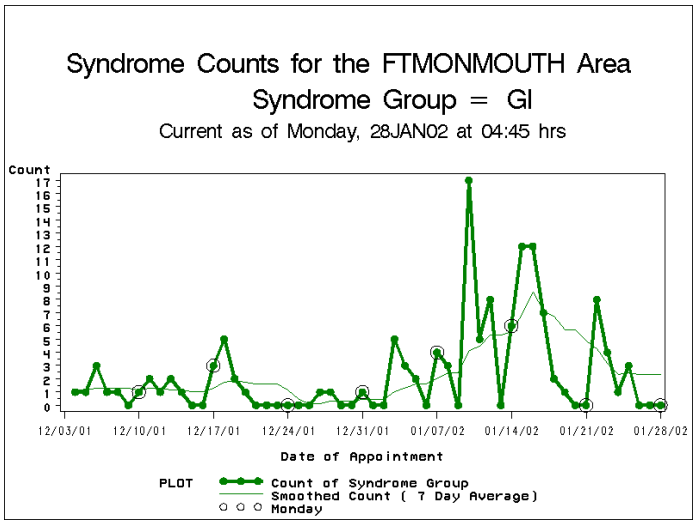
  All fixed MTFs world-wide including:

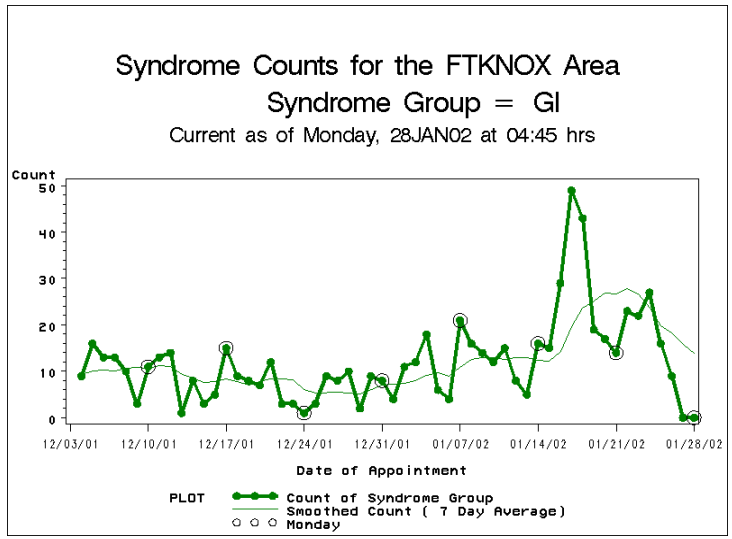
  - 121 Army, 110 Navy, 80 AF and 2 CG installations
  - grouped into 179 geographic clusters

Expanded geographic coverage allowed detection of concurrent outbreaks









2. Syndrome definition

Problem

- Would like to identify outbreaks faster than traditional methods

- Lack of universally applied syndrome definitions or code groups

Participating Agencies

- National Center for Infectious Diseases and Epidemiology Program Office, Centers for Disease Control and Prevention, Atlanta, Georgia
- Division of Preventive Medicine, Walter Reed Army Institute of Research (WRAIR), Silver Spring, Maryland
- Emergency Medical Associates of New Jersey Research Foundation, Livingston, New Jersey
- Bureau of Epidemiology Services, New York City Department of Health and Mental Hygiene, New York City, New York
- Harvard Medical School and Harvard Pilgrim Health Care, Boston, Massachusetts

Objectives

- Determine appropriate syndromic groups for infectious disease surveillance and for surveillance of agents of bioterrorism.

- Review and compare different sources of medical data to best develop ICD-9-CM code groups applicable to multiple users.

Which ICD9 Codes Should We Map to Syndrome Groups?

- Clinical decision
  - **What are the diseases we are trying to detect?**
    - **Define the syndromes**
  - **What diagnoses fit under this syndrome definition?**

- Trend analysis
  - **How frequently are candidate codes used?**
  - **Is there an expected trend for the syndrome?**
  - **Is there a "gold standard" for comparing the trend?**
    - **How well do other ICD9s correlate with the gold standard?**
    - **Do any ICD9s show the same peak/trend earlier?**

Which Syndrome Groups Should We Choose?

Botulism	Botulism-like
VHF	Hemorrhagic Illness
Plague (Bubonic)	Lymphadenitis
Anthrax (cutaneous), Tularemia	Localized Cutaneous Lesion
Anthrax (gastrointestinal)	Gastrointestinal
Anthrax (inhalational), Tularemia	Respiratory
Plague (pneumonic)	
Small Pox	Rash

Syndrome Groups Selected by Consensus

- Botulism-like
- Hemorrhagic Illness
- Lymphadenitis
- Localized Cutaneous Lesion
- Gastrointestinal
- Respiratory
- Rash
- Neurological
- Specific Infection
- Fever
- Severe illness or death potentially due to infectious disease

Customize Syndrome Groups

Standard Set

- Botulism-like
- Hemorrhagic Illness
- Lymphadenitis
- Localized Cutaneous Lesion
- Gastrointestinal
- Respiratory
- Rash
- Specific Infection
- Fever
- Neurological
- Severe Illness or Death Potentially Due to Infectious Disease

WRAIR Set

- Botulism-like
- Hemorrhagic Illness
- Gastrointestinal
- Respiratory
- Rash
- Fever
- Neurological
- Shock/Coma

Syndrome Definition- Respiratory Example

Syndrome	Definition	Cat A Agent
Respiratory	ACUTE infection of the upper and/ or lower respiratory tract (from the oropharynx to the lungs, includes otitis media) SPECIFIC diagnosis of acute respiratory tract infection (RTI) such as pneumonia due to parainfluenza virus ACUTE non-specific diagnosis of RTI such as sinusitis, pharyngitis, laryngitis ACUTE non-specific symptoms of RTI such as cough, stridor, shortness of breath, throat pain EXCLUDES chronic conditions such as chronic bronchitis, asthma without acute exacerbation, chronic sinusitis, allergic conditions (Note: INCLUDE *acute exacerbation* of chronic illnesses.)	Anthrax - inhalation Tularemia Plague - pneumonic

Trend Analysis

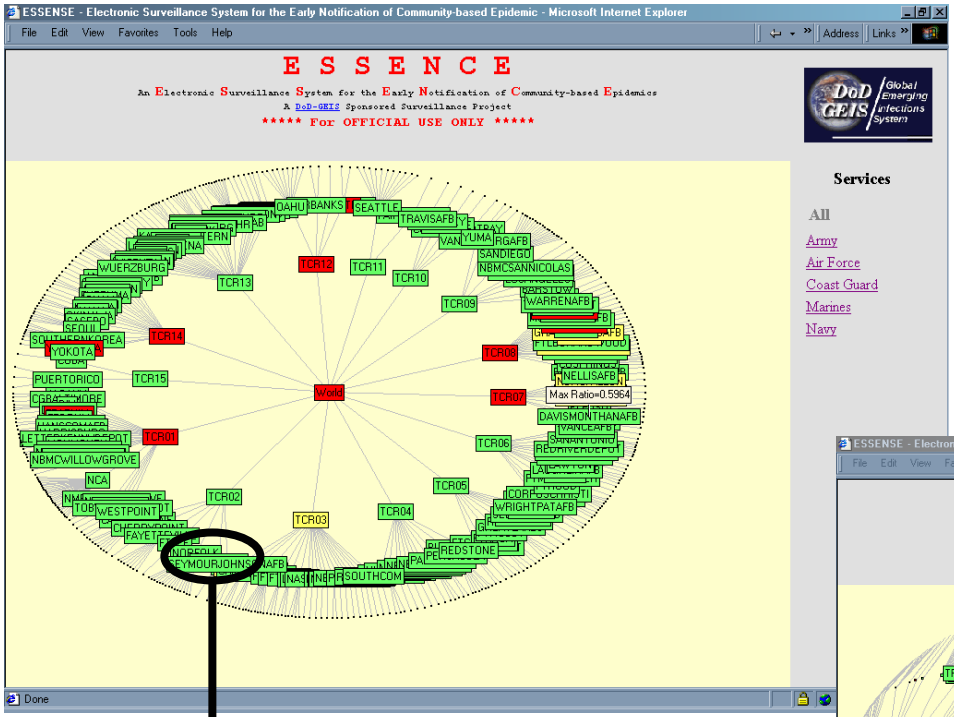
- Is there an expected trend for the syndrome?
- Is there a “gold standard” for comparing the trend?
    - How well do other ICD9s correlate with the gold standard?
    - Do any ICD9s show the same peak/trend earlier?

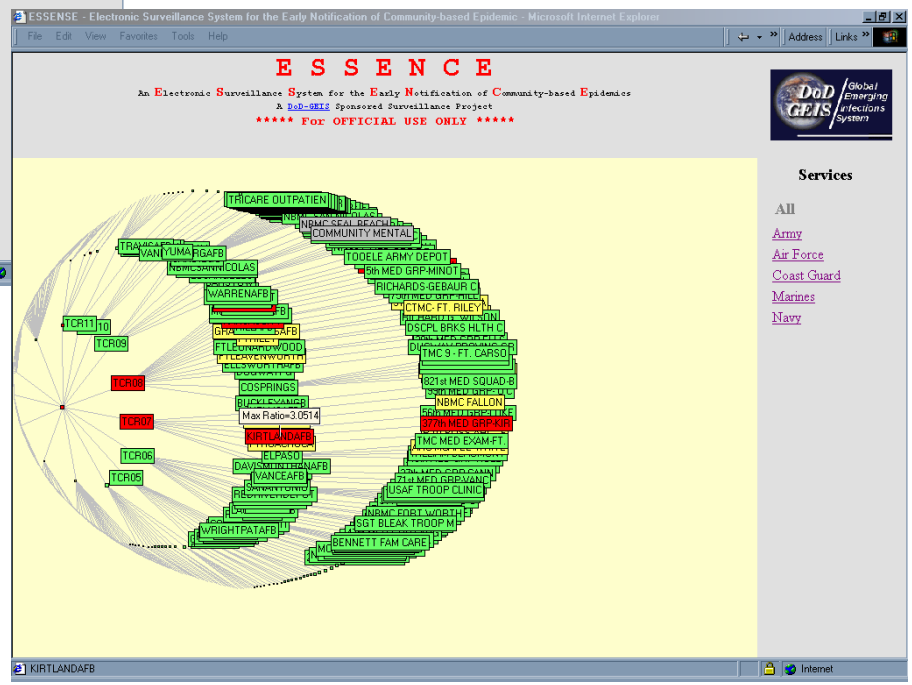
One Approach

1. Begin with a larger set of potential ICD9s identified clinically
2. Select those with counts>10 per day
3. Daily and Weekly analyses
   a) Correlation matrix/ Lagged Correlation
   b) Factor analysis
   c) Regression
   d) Signal-Noise
   e) Testing sensitivity/ timeliness for known outbreaks

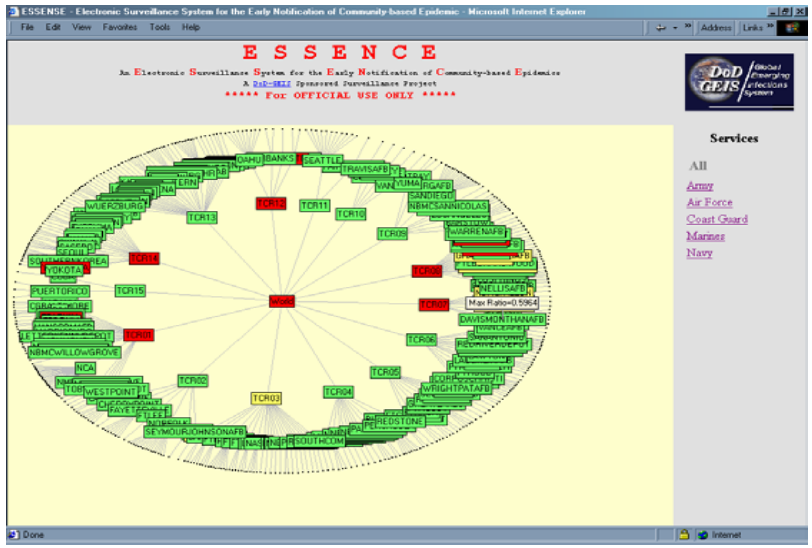
3. Data display

- Web-based
- Interactive or static screens
- Software or “home grown” programs
- System maintenance

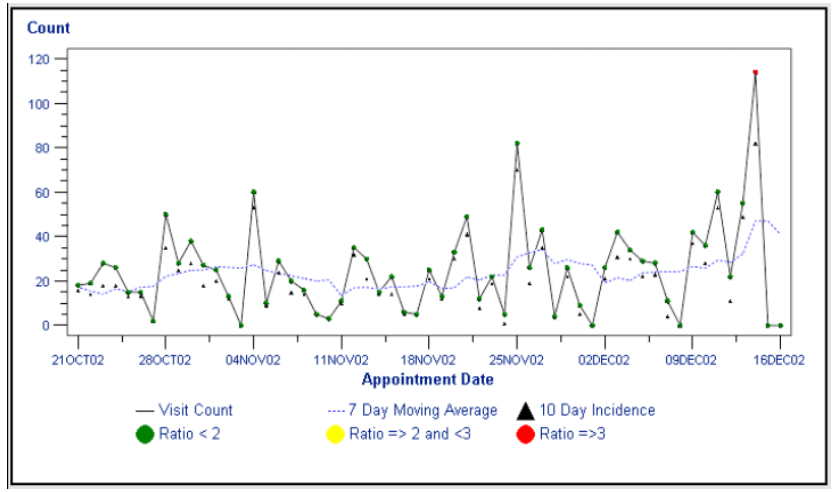




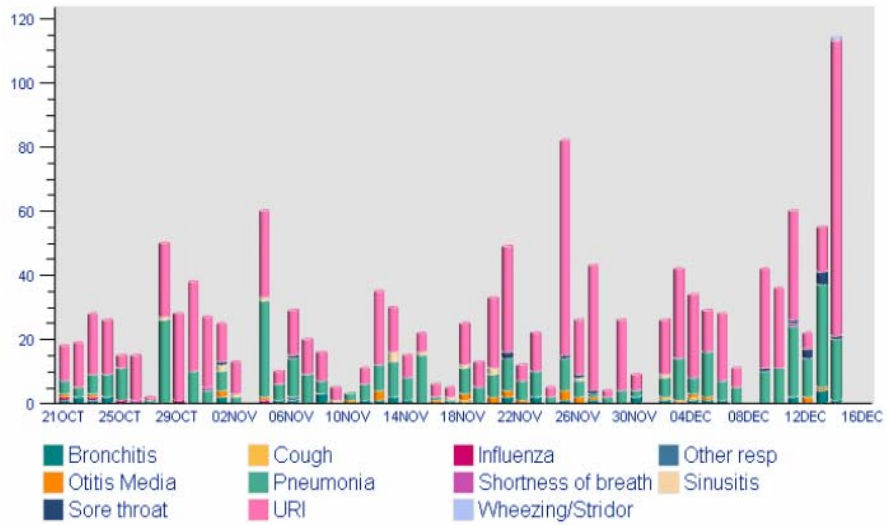
Facility_Name	DMIS_ID
1st MEDICAL GROUP	0120
MCDONALD ACH	0121
NMC PORTSMOUTH	0124
MONROE AHC	0372
NAS NORFOLK NRMC/BC	0377
BMC LITTLE CREEK	0378
BMC NSY NORFOLK	0380
BMC YORKTOWN	0381
BMC DAM NECK	0382
BMC OCEANA	0387
PORTSMOUTH USCG CLINIC	0432
YORKTOWN USCG CLINIC	0433
AHC FT. STORY	0464
BMC LAFAYETTE RIVER	0505
BMC NAVSTA SEWELLS	0508
BMC CHESAPEAKE	0519
NAVY NAVCARE CLINIC NORFOLK (1)	6204
TRICARE OUTPATIENT CLINIC VA BEACH	6214
TRICARE OUTPATIENT CHESAPEAKE	6221
BMC WALLOPS ISLAND	7017
1st AIR TRANSPORTABLE HOSPITAL	7056



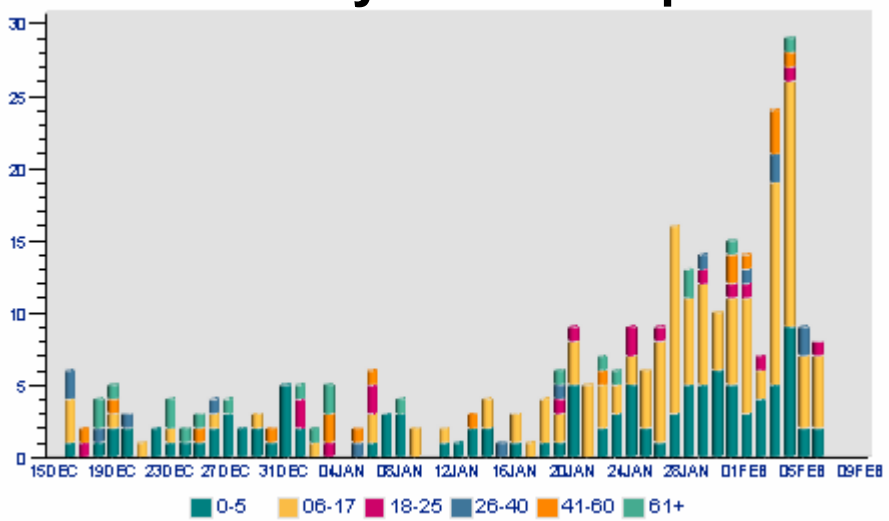
Daily Number of Visits



Visits by Age Group



Visits by ICD9 Group



4. Identify abnormal trends

- Alert detection models
  - Statistical algorithms
- Visual tests

Statistical models used for alert detection in ESSENCE

- Exponentially Weighted Moving Average (EWMA)
  - Predictions based on exponential smoothing of previous several weeks of data
  - Recent days have highest weight
- Autoregression (AR)
  - Predictions based on past several weeks of data
  - Incorporates and adjusts for day of the week and holiday trends
- SatScan
  - Detects geographic clusters by comparing number of cases within overlapping circles

5. Privacy protection

- HIPPA
- De-identified data
- Password protection
- Secure website

6. Evaluation of data sources

- Comparison to gold standards
  - Chart review
  - Sentinel studies

- User feedback

Using ESSENCE architecture to survey for other problems

- Mental health visits and anxiety medication
- Sexually transmitted diseases
- Reportable diseases
- Military Disease and Non-battle Injury (DNBI)